

OPEN CHANNEL

(ft.)
CODE 878



(Source: Neil Pellmann, Will-South Cook SWCD)

DEFINITION

Construction of or improvement to a channel in which water flows with a free surface and base flow.

PURPOSE

The purpose of this practice standard is to provide stormwater conveyance and discharge capacity required for flood prevention, drainage, and/or other authorized water management purposes.

CONDITIONS WHERE PRACTICE APPLIES

1. Construction of earth channels
2. Modification of existing streams or ditches
3. Where stability requirements can be met
4. Where an adequate outlet for the channel reach is available for discharge by gravity flow
5. Where excavation or other channel work does not cause significant erosion, flooding, or sedimentation

CRITERIA

General – Channel construction or modification shall be according to the design criteria in NRCS TR-25 – Design of Open Channels (efotg.nrcs.usda.gov/references/public/WI/582.pdf). Design criteria in TR-25 shall be followed, using the procedure best adapted to site conditions.

The alignment of the channel undergoing modification shall not be changed to the extent that the stability and morphology of the channel (or laterals thereto) is endangered.

Capacity – The capacity for open channels shall be determined according to procedures applicable to the purposes to be served and according to related engineering standards and guidelines. The water surface profile or hydraulic gradeline for design flow shall be determined according to guidelines for hydraulic design in TR-25. The “n” value for aged channels shall be based on the expected vegetation, along with other retardance factors, considering the level of maintenance prescribed in the operation and maintenance plan.

Cross Section – The open channel cross section shall be trapezoidal, parabolic, v-shaped, or (where permitted) rectangular. The required channel cross section and grade shall be determined by the plan objective, the design capacity, the materials in which the channel is to be constructed, the vegetative establishment program, and the requirements for operation and maintenance.

Channel Stability – Characteristics of a stable channel shall include:

1. The channel neither aggrades nor degrades beyond tolerable limits
2. The channel banks do not erode to the extent that the channel cross section is changed appreciably
3. Sediment bars that are not excessive
4. Gullies do not form or enlarge because of the entry of uncontrolled surface flow to the channel

All channel construction and modification (including clearing and snagging) shall be according to a design that can be expected to result in a stable channel. Vegetation, riprap, revetments, linings, structures, or other measures shall be used if necessary to insure stability.

The method applicable to site channel in TR-25 shall be used in determining the stability of proposed channel improvements.

Channels shall be stable under conditions existing immediately after construction (as-built condition) and under conditions existing during the effective design life (aged condition). Channel stability shall be determined for discharges under these conditions as follows:

1. As-built condition – Bankfull flow, design discharge, or 10-year

frequency flow, whichever is smallest, but not less than 50 percent of design discharge.

2. The allowable as-built velocity (regardless of type of stability analysis) in the newly constructed channel may be increased by a maximum of 20 percent if:
- 3.
4. a) The soil and site in which the channel is to be constructed are suitable for rapid establishment and support of erosion-controlling vegetation,
5. b) Species of erosion-controlling vegetation adapted to the area and proven methods of establishment are known, and
6. c) The channel design includes detailed plans for establishing vegetation on the channel side slopes.
7. Aged condition – Bankfull flow or design discharge, whichever is larger, except that it is not necessary to check stability for discharge greater than the 100-year frequency.

Flow-related stability including riffles or checks shall not be required if the velocity is 2 ft/sec or less.

For newly constructed channels in fine-grained soils and sands, the “n” value shall be determined according to procedures in Chapter 6 of TR-25 and shall not exceed 0.025. The “n” value for channels to be modified by clearing and snagging only shall be determined by reaches according to the expected channel condition upon completion of the work.

Appurtenant Structures – The channel design shall include all structures required for proper functioning of the channel and its laterals. Inlets and

structures needed for entry of surface and subsurface flow into channels without significant erosion or degradation shall be included in the channel design. The design shall also provide for necessary flood gates, water-level-control devices, bays used in connection with pumping plants, and any other appurtenances essential to the functioning of channels and contributing to attainment of the purposes for which they are built. If needed, protective structures or treatment shall be used at junctions between channels to insure stability at these critical locations.

The effect of channel work on existing culverts, bridges, buried cables, pipelines, irrigation flues, and inlet structures for surface and subsurface drainage on the channel and laterals thereto shall be evaluated to determine the need for modification or replacement.

Culverts and bridges modified or added as part of channel projects shall meet reasonable standards for the type of structure and shall have a minimum capacity equal to the design discharge or the design requirements of the applicable governing agency, whichever is greater.

Disposition of Spoil – Spoil material from clearing, grubbing, and channel excavation shall be disposed of in a manner that will:

1. Not confine or direct flows so as to cause instability when the discharge is greater than the bankfull flow.
2. Provide for the free flow of water between the channel and floodplain unless the valley routing and water surface profile are based on continuous dikes being installed.
3. Not hinder the development of travelways for maintenance.

4. Leave the right-of-way in the best condition feasible, consistent with the project purposes and adjacent land uses.
5. Direct water accumulating on or behind spoil areas to protect outlets.
6. Maintain or improve the visual quality of the site to the extent feasible.
7. Will not damage trees.

Vegetation of Channel – Vegetation shall be established on all channel slopes, berms, spoil, and other disturbed areas according to practice standards such as: EROSION CONTROL BLANKET 830, EROSION CONTROL BLANKET – TURF REINFORCEMENT MAT (TRM) 831, PERMANENT VEGETATION 880, MULCHING 875, or VEGETATIVE STREAMBANK STABILIZATION 995.

Construction – Earth excavation and embankment shall be in accordance with construction standards 21 EXCAVATION and 23 EARTHFILL. Channel construction shall be in accordance with construction specification 4 CHANNEL CLEARING AND SHAPING and 61 ROCK RIPRAP.

Temporary soil erosion control and sediment protection shall be used during construction including EROSION CONTROL BLANKET 830, EROSION CONTROL BLANKET – TURF REINFORCEMENT MAT (TRM) 831, or MULCHING 875. Use construction specification 61 ROCK RIPRAP and Material Specification 592 GEOTEXTILE where appropriate.

For channels with considerable erosion potential additional or permanent measures may need to be taken. See practice standards LINED CHANNEL OR OUTLET 872, SOIL BIOENGINEERING 926, STONE-LINED CENTER VEGETATED SWALE 931,

TEMPORARY STREAM DIVERSION 976.

Access – Access to the open channel shall be provided in the design as required for inspections and maintenance.

CONSIDERATIONS

In selecting the location and design of the channel, careful consideration should be given to minimizing water pollution, damage to fish and wildlife habitat, and to protecting forest resources and the quality of the landscape. In considering requirements for construction and operation and maintenance, selected woody plants should be preserved. The overall landscape character, prominent view, and fish and wildlife habitat requirements should be considered.

Planned measures necessary to mitigate unavoidable losses to fish or wildlife habitat should be included in the project. The quality of the landscape should be maintained by both the location of the channel and plantings.

For water quality improvement, check dams or rock riffles can be used to decrease flow rates, increase dissolved oxygen, and promote infiltration. See practice standard ROCK CHECK DAM 905.

PLANS AND SPECIFICATIONS

Plans and specifications for modifying or constructing open channels shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. At a minimum include the following items:

1. Channel location and alignment
2. Grade, depth and width
3. Channel cross section type
4. Construction specification that describes in writing the site specific installation requirements of the open

channel

5. Type of erosion control selected

All plans shall include the installation, inspection, and maintenance schedules with the responsible party identified.

OPERATION AND MAINTENANCE

Plan – An operation and maintenance plan shall be prepared for each channel system. Minimum requirements for operation, maintenance, and replacement shall be consistent with the design objectives. The operation and maintenance plan shall include consideration of fish and wildlife habitat, quality of the landscape, water quality, mitigation features, methods, equipment, costs, stability, function for design life, frequency, and time of year for accomplishing the work. Detailed provisions for operation and maintenance shall be made if complex features, such as water-level-control structures and pumping plants are required.

Maintenance Access – Travelways for maintenance shall be provided as part of all channel work. This requirement may be met by providing reading access points to section of the channel if this will permit adequate maintenance in conformance with the operation and maintenance plan.

A travelway shall be provided on each side of large channels if necessary for use of maintenance equipment. Travelways must be adequate for movement and operation of equipment required for maintenance of the channel. The travelway may be located adjacent to the channel on a berm or on the spread spoil. In some places the channel itself may be used as the travelway. The travelway, including access points, must blend into the topography, the landscape, and the adjacent land uses.

Safety – Open channels can create a safety hazard. Appropriate safety features and devices shall be installed to protect people and animals from accidents such as falling or drowning.

REFERENCES

United States Department of Agriculture,
National Resources Conservation
Service Technical Release 25, Design of
Open Channels.

National Resources Conservation
Service, Wisconsin. Conservation
Practice Standard Open Channel 582.
April 2009.

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